# PUTTING THE 'UNITED' IN THE UNITED REPUBLIC OF TANZANIA: RECONSTRUCTING MARINE FISHERIES CATCHES[1]

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## ABSTRACT

This study reconstructs marine fisheries catches from 1950-2005 for the United Republic of Tanzania, comprised of mainland Tanganyika and several offshore islands, two of which make up the region of Zanzibar. For unknown reasons, Zanzibar's recorded fisheries data are absent from the marine fisheries landings reported by the United Nations Food and Agriculture Organization (FAO) on behalf of Tanzania. Furthermore, the mainland fisheries catches were likely at least one-third larger than those reported by the official data, due to incomplete country-wide expansion of locally sub-sampled catches. Since 2000, Tanzanian mainland fishers have likely caught around 70,000 tonnes annually, while Zanzibar catch estimates are around 25,000 tonnes per year. Overall, the United Republic of Tanzania has likely caught nearly 100,000 tonnes of marine fish per annum in recent years and total marine fisheries catches are likely 1.7 times greater than those presented by the FAO. These findings support broader research in the Western Indian Ocean that found historic FAO data to reflect about half of the real total catch in the region. These findings also call into question current understanding of fisheries stock exploitation in Tanzania and the recent decision by the Tanzanian government to commence export of marine finfish.

## INTRODUCTION

### *Historical Perspective*

Tanzania, located in East Africa, has a mainland coastline of approximately 800 km and three large offshore islands: Mafia, Pemba, and the island of Zanzibar, around which much inshore fishing is concentrated (Mngulwi, 2006). Pemba and the island of Zanzibar form the region of Zanzibar. In the past, the mainland (called Tanganyika) and Zanzibar were separate entities. Both Tanganyika and Zanzibar fell under German colonial control in 1886 and then to the British in 1920, after WWI. Tanganyika gained independence in 1961 and Zanzibar followed two years later. In 1964, the two countries merged as the United Republic of Tanzania (Figure 1).

Lake Victoria has been the primary center of fishing, due partially to the fact that freshwater fishing is less capital intensive than marine fishing (Bagachwa *et al.*, 1994). Thus, most fisheries reports concentrate on freshwater catches (Anon., 1978). But subsistence marine fisheries have long provided protein for Tanzanian coastal and island communities (Anon., 1920).

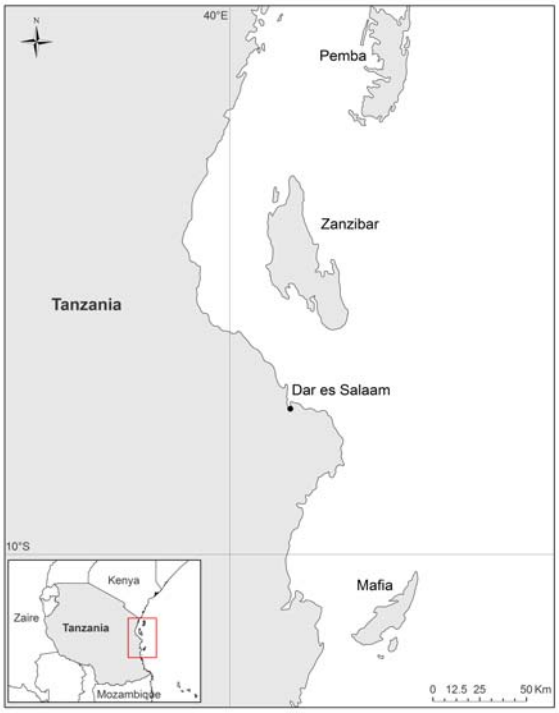


**Figure 1:** Tanzania, East Africa, and its three large offshore islands.

Prior to independence, fishers fished for small pelagic

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and demersal species using nets, traps, and hook and line. Women used a piece of sacking or a discarded *khanga* (printed cotton material worn as clothing) to catch prawns in the shallows (Wenban-Smith, 1965). Women and children also collected invertebrates. Fishing using ichthiotoxic plants and sea cucumbers was also common during the late 19th century (Stubbings, 1945). Wads of plants covered in the poison were thrown into estuaries where they stunned many fish that were then caught at the mouth of the river with a net. Legislation made fish poison illegal and, by the end of first half of the 20th century, the practice was less common (Alexander, 1964). The seafood trade in Tanzanian waters also has a long history. The export of fish and fisheries products from Zanzibar, for instance, dates back to the 13th century when Persians, Arabs, and Indians traded dried salted fish (particularly kingfish), shells, shark fins, and later, sea cucumber (Mgawe, 2005).

During the colonial period (1880s-1960s), sportfishing became increasingly common in Tanzanian waters (Hatchell, 1940). At independence, commercial fishing began with the introduction of the purse seine in the Zanzibar channel for small pelagics, i.e., sardines, scads, mackerel, and anchovies (Nhwani, 1981). After independence, the new Tanzanian government practiced an African socialist policy and, under this regime, implemented a ban on the export of marine finfish to protect food security (Anderson and Ngatunga, 2005), though the ban does not seem to apply to Zanzibar (Jiddawi, 2000).

Despite its nominally socialist policies, Tanzania allowed a large amount of foreign investment, including the introduction of shrimp trawling—a practice that, given the amount of wasted fish produced by trawling, seems ironic in light of the export ban on marine finfish. However, the export of shrimp was allowed and began to grow. In the mid 1960s, a Japanese company and the Tanzanian government formed a shrimp company, though the Japanese left in 1975 (Bwathondi and Mwaya, 1984) and the fleet was nationalized. With the rise of the shrimp fishery there was a great deal of bycatch, as much of 94 percent in the 1980s, though it is difficult to determine how much of this was retained and how much discarded (Nanyaro, 1984). It was reported that, in the 1980s and 1990s, the dumping of finfish discards was so great that it was polluting inshore waters. This waste was later addressed by improved enforcement and much of the bycatch is now sold onshore to local markets or processing facilities (Shao *et al.*, 2003).

A number of commercial cooperatives operated through the 1980s, including the Zanzibar Fishing Company (ZAFICO), the Bagamoyo Fishing Company (BAFICO), and the Tanzania Fishing Company (TAFICO) (Ngoile, 1982; Nanyaro, 1984). After trade liberalization began in 1985, a number of small-scale entrepreneurs as well as commercial and foreign trawlers became involved in the fishing sector and, in some cases, tripled fishing effort (Bakari and Andersson, 1999). In the 1980s, a market developed for the export of live aquaria fish (Mongi, 1991). In the early 1990s, Tanzania signed access agreements and allowed the EU to catch 7000 t of tuna annually (Mongi, 1991).

In the mid-1990s, tourism grew and so did demand for fresh fish and shellfish. On the mainland, the number of tourists increased from 82,000 in 1985 to 341,000 in 1996 (Coughanowr *et al.*, 1995; Bakari and Andersson, 1999), which was reflected in the Tanzanian lobster fishery. In 1968, there were 22 permits issued for fishing crustaceans (Anon., 1988). By 1987, there were 415 boats fishing lobster, which far exceeded the upper limits of the effort recommended for the fishery. In 1988, the lobster catch in Tanzania peaked. Since then, the average size of lobster has decreased (Bakari and Andersson, 1999).

In the 1990s, tourism also developed rapidly in Zanzibar. With the increase in tourism came an increase in demand for high-quality fresh fish. Tourist hotels offer good markets for fresh fish and prawns and hotel representatives now attend the fish auction in Kigomani, Zanzibar (Richmond, 1999). Tourism also increased demand for marine curios, such as shark jaws, shark teeth, and shells (Jiddawi, 2000; Shao *et al.*, 2003). Roughly 150 species of shells are collected by fishers for food or sold as curios (Jiddawi and Öhman, 2002). The most sought after shells by tourists are Horned Helmut shell, Triton trumpet shell, and Mauritian cowry. A shell survey done in the market in Dar es Salaam in 1998 found 112 species on sale with a total of 22,659 specimens. Seven years later, only 87 species were available on the market though there were 39,259 specimens. The number of Red Helmut shells (*Cypraecassis rufa*) in the market declined by 55 percent over the same time period (Sabel, 2005).

## *Tanzanian Small-scale Fisheries Today*

In many ways, small-scale fisheries resemble those from a century ago. Small-scale fishing takes place almost exclusively in the nearshore waters of 40 m depth or less (UNEP, 2001) by means of outrigger canoes and dhow-type planked boats, mostly propelled by sails (Mngulwi, 2006). Dhows are still caulked with shark oil. Fishers use lines, traps, and nets to catch demersals, purse seines and scoop nets to catch small pelagics, and longlines, drift nets, gillnets, and shark nets to catch large pelagics. Like most small-

scale fishing in the tropics, many species are caught and almost nothing is discarded. In Zanzibar, fishers from the villages exploit at least 61 families of fish (Jiddawi and Stanley, 1999).

Women and children still harvest shellfish, octopus, squid, crabs, sea cucumbers, and mollusks in the intertidal zone and mangrove areas using their hands, hooks, and natural and synthetic poisons (Semesi and Ngoile, 1993; Guard *et al.*, 2000; Silva, 2006). Women also beach seine for very small shrimp, which is quite profitable.

According to the 2005 fisheries frame survey, there are 29,754 fishers, 796 collectors, and 7190 boats on the Tanzanian mainland. No such survey has been conducted recently on Zanzibar, but it is estimated there are more than 23,000 fishers and collectors there (Jiddawi, 2000). There are more than 400 landing sites for the mainland and Zanzibar combined (Jiddawi and Muhando, 1990; Shao *et al.*, 2003). The majority of fish is eaten fresh though some is dried, smoked, fried, and/or salted (Tobey and Torell, 2006). Like other small-scale fisheries of East Africa (van der Elst, 2003), Tanzanian fisheries are subject to little management, and destructive (and illegal) fishing practices are common, such as use of herbicides, pesticides, beach seines and dynamite (Haule and Kiwia, 1999; Othman, 1999; Verheij *et al.*, 2004).

### Dynamite fishing

The most discussed form of destructive fishing in Tanzania is dynamite, which was introduced in Tanzania in the early 1960s (Haule and Kiwia, 1999). Dynamite tends to be used during specific times of year (holidays and the beginning of the school year) when households need extra cash (Silva, 2006). Dynamite fishing had immediate negative consequences in Tanzania since it destroys the habitat upon which fisheries depend. Coral cover in Tanzania has greatly diminished and Kenyan and Tanzanian reefs are the most severely damaged in East Africa (Obura *et al.*, 2002). In East Africa as a whole, it is estimated that coral cover has decreased by half from 1997 to 2002 (Obura *et al.*, 2002).

In the late 1960s, the reef adjacent to Tanga in northern Tanzania was described as some of Tanzania's best. By 1987, an IUCN study showed the reef was extensively damaged. Fewer than 20 percent of the areas surveyed were covered in live coral. At Tanga, 12 percent of the 83 reef sites surveyed were completely destroyed by dynamite fishing (Guard *et al.*, 2000). Though enforcement existed, the two Tanga District Fisheries Officers were caught taking bribes from dynamite fishers (Horrill and Makoloweka, 1998).

Even after dynamite was made illegal, frequent dynamite blasting occurred despite public protests (Bryceson, 1981). In some villages, there were complaints of intimidation from dynamiters and cases of brutality (Horrill and Makoloweka, 1998). In just two months in 1996, 441 dynamite blasts were recorded at Mnazi Bay, Mtwara (Darwall *et al.*, 2000). In addition to the destruction of corals, the ease of use of dynamite also has the consequence of lost knowledge for future generations of fishers in terms of how to fish using traditional techniques (Darwall *et al.*, 2000).

As late as 2002, the elimination of dynamite was still the main priority in southern Tanzania (Darwall *et al.*, 2000) where dynamite fishing remained prolific along the coast (Bryceson, 1981; Andersson and Ngazi, 1995; Guard, 1999; Guard *et al.*, 2000). Today, dynamite use has greatly declined because the punishment for its use includes a much more substantial fine and a minimum of three years in jail (Horrill and Makoloweka, 1998; Guard *et al.*, 2000). In some areas, there are signs of recovery and coral cover is increasing, while sea urchin densities, a sign of disturbance, are decreasing (Verheij *et al.*, 2004).

Unfortunately, many young men who used dynamite turned to the illegal practice of coral mining, instead (Luhikula, 1998). Mining for coral for construction materials, particularly on Mafia Island, has also been highly damaging to fish and coral populations (Andersson and Ngazi, 1995; Dulvy *et al.*, 1995; Guard *et al.*, 2000). On mined sites, fish abundance was 42 percent lower and fish diversity 24 percent lower than on un-mined sites. On average, coral cover was reduced 70 percent (Dulvy *et al.*, 1995).

## *Data: Collection, Reporting, and Underreporting*

According to official data in recent years, total reported fish catches in Tanzania are estimated between 300-400,000 t annually, of which marine catches account for only approximately 50,000 t (Mgawe, 2005). According to the national data, small-scale fisheries contribute more than 96 percent of total marine catches (Fisheries Division, 2005). However, the collection of accurate marine fisheries statistics has long been considered difficult or near impossible (Anon., 1988). Also, many records from the colonial era were also lost.

The newly independent government began the collection of fisheries statistics in Tanzania in the 1960s and chose several fishing villages to be monitored continually. Ideally, two recorders were stationed at each centre and recorded the weight and value by species of fish landed by every vessel. The monthly catches at each centre were meant to be extrapolated to the whole statistical area using a frame survey of the number of boats and gear types to obtain annual catch estimates (Nhwani, 1981).

During the 1970s, some improvements to data collection were made with the distribution of lists of species names and scales for each monitoring site (Nhwani, 1984). For instance, in 1975, the Government of Zanzibar ordered fish to be weighed so that fish would be sold by weight and consumers would receive fair prices (Othman, 1999) although weight was still visually estimated on Pemba until only recently (Othman, 1999). That same decade, the national government began decentralizing its power and one result was that there was little emphasis on monitoring fisheries in some regions (Nhwani, 1984).

In 1984, the Tanzanian national fisheries statistics office did not own even a simple calculator (Nhwani, 1984). That same year, due to financial constraints in the Zanzibar fisheries office, the number of beach recorders was reduced from 38 to 8 on Pemba and these 8 recorders returned to the visual estimation procedure (Othman, 1999). In 1988, collection methods improved as fish recorders were added to the Zanzibar Fisheries Department (Jiddawi and Muhando, 1990).

Industrial data are also likely underreported since collection relied on reports from the fisheries companies, which were inconsistent and, for foreign vessels, entirely unreported (Nhwani, 1981). Tuna, swordfish, sea cucumber, and prawn fisheries greatly misrepresent their catch (Anderson and Ngatunga, 2005). Jiddawi and Ohman (2002) point out that shark fin traders give a figure that is more than double what is reported officially. Middlemen, particularly those in the Pemba octopus fishery, also provide misinformation (Othman, 1999)

More recent data are also insufficient, which is disclosed in FAO reports (Mongi, 1991) and the data from the small-scale fishery are particularly inadequate (Guard *et al.*, 2000) as they omit the catch by collectors (often women and children) and often transfers at sea. Close analysis of FAO data reveals not only underreporting of Tanzanian data but also the omission entirely of Zanzibar from official statistics. This is likely due to the complexity of Tanzanian bureaucracy: Mainland Tanzania and Zanzibar each have autonomous institutional and legal structures for managing fisheries, and thus have separate systems of reporting. Additionally, Zanzibar Fisheries Division must account for catch statistics on the islands of Unguja and Pemba, which further complicates reporting. This research aims to give a time series estimate of national fisheries catches from 1950-2005 for both mainland Tanzania and Zanzibar.

## MATERIALS AND METHODS

Peer-reviewed publications on Tanzanian marine fisheries are rare - most reports center on Lake Victoria fisheries. The few reports that do exist are fairly recent.

Furthermore, because freshwater catches account for the majority of consumed fish nationwide, using consumption data to inform marine fisheries catch reconstructions was not possible. Though there may be anecdotes, there is often little scientific evidence to provide a view of fisheries 25 or more years ago. Jiddawi (2000) demonstrates this for Tanzania with a figure of fisheries publications through time: there were fewer than 5 fisheries research reports completed in 1900 while there were 120 reports written in 1990. Jiddawi and Stanley (1999), for instance, conducted the first comprehensive fisheries catches study in Zanzibar in the 1990s and provided "a first look at the relative status compared to other fisheries in the world."

Data for the present reconstructions were thus mostly obtained through gray literature and tables produced by the Fisheries Division and other local institutions in Tanzania (e.g., TAFIRI, TCMP, TRAFFIC, WWF). The majority of these reports did not elaborate on the methodology behind the data presented. Frontier (www.frontier.ac.uk), a non-profit organization from Britain, has done regional studies on small-scale fishing since 1989 but was, unfortunately, unwilling to share data.

### *Zanzibar*

For Zanzibar, fisheries catches were available from 1982-2005, with the exception of 1989, which was interpolated. For 1980 and 1981, the data appeared to represent only the catch from the island of Unguja. For 1980, we had reliable data for the number of fishers on Unguja and Pemba: 5884 and 7058 respectively (Table 1). Using the 1980 reported catch for the island of Zanzibar (3965 t) divided by the number of fishers (5884) we obtained a catch per fisher of 0.67 t·year$^{-1}$. We multiplied this catch rate by

the 7058 fishers in Pemba to establish the Pemba catch: 4756 t for 1980. For 1981, we interpolated the number of fishers between frame surveys (1980 and 1985) and then repeated the steps used to determine the 1980 data to determine the 1981 catch data for Pemba, which gave us 6942 t for Pemba in 1981.

Aggregating the 1980 and 1981 data for the islands of Pemba and Zanzibar, we obtained catch estimates for Zanzibar as a whole from 1980-2005 for canoe fishers, but these did not include the catch by collectors. There were three years with reliable numbers of collectors on each island: 1980, 1985, 1989. We interpolated the number of collectors between these years to determine the number of collectors from 1980-1989 (Table 1).

**Table 1.** Number of fishers on the islands of Zanzibar and Pemba, and number of collectors on both islands combined (Zanzibar total), 1980-1989.

| Year | No. of fishers (Zanzibar island) | No. of fishers (Pemba island) | Collectors (Zanzibar total) |
|---|---|---|---|
| 1980 | 5,884[a] | 7,058[a] | 4,555[a] |
| 1981 | 5,954 | 7,194 | 3,937 |
| 1982 | 6,024 | 7,330 | 3,319 |
| 1983 | 6,094 | 7,467 | 2,700 |
| 1984 | 6,164 | 7,603 | 2,082 |
| 1985 | 6,234[b] | 7,739[b] | 1,464[b] |
| 1986 | - | - | 1,679 |
| 1987 | - | - | 1,894 |
| 1988 | - | - | 2,108 |
| 1989 | - | - | 2,323[c] |

[a] (Ngoile, 1982) [b] (Carrara, 1987) [c] (Mongi, 1991)

A study from Matemwe, Zanzibar estimated catch rates for collectors to be 4.0 kg·collector$^{-1}$ (Jiddawi and Stanley, 1999). At Matemwe, fishers go to sea 16-20 days per month, while in other parts of Zanzibar fishers go to sea as often as 25 days per month (N. Jiddawi, Institute of Marine Sciences, pers. comm.). For the purposes of this study, we assumed the catch rates from Matemwe to represent the average catch for collectors, likely conservative because catch rates, at least anecdotally, have declined. Thus, we assumed a catch rate for collectors to be 4.0 kg·collector$^{-1}$ and an effort of 20 days per month (240 days each year). This rate and effort was multiplied by the time series of collectors (from 1980-1989) to obtain collector catches from 1980-1989.

Because 1989 was the last reliable data point for the number of collectors in Zanzibar, we used the ratio of collected fish to caught fish in 1989 (23:100) and used this ratio to obtain a time series of collected fish from 1990-2005 based on a constant proportion to reported fisheries catches.

From 1950-1980, we had only two data points for fisheries catches: catch estimates for 1975 (12,500 t) and 1959 (8500 t), which was presumed not to include collectors. We thus interpolated fisheries data from 1976-1979 and 1960-1974. From 1950-1958, we extrapolated the catch backward based on the linearly increasing catches interpolated annually from 1959-1975 (an increase of 250 t annually). Based on the ratio of collected fish to caught fish in 1980 (33:100), we assumed this constant ratio and determined the collected catch from 1950-1979. We aggregated the fished and collected estimated catch for a time series of Zanzibar marine fisheries catches from 1950-2005.

## *Mainland Tanzania*

For the Tanzanian mainland, we retained the estimated fisheries data reported by the FAO for the years 1950-1969, which were probably the best estimates we could obtain. In the absence of reliable number of fishers, consumption data, or catch rates for this time period, these data were likely 'estimates' given that they were round numbers in increments of hundreds.

For reasons mentioned above, the official marine catches for the Tanzania mainland from 1970-2005 that we obtained were likely underestimated. A new system of data collection practiced in Tanga (the northern-most province) and published in a peer-reviewed journal demonstrated catches were approximately 35 percent greater than previously believed (Verheij *et al.*, 2004). Based on this regional study, we increased the 1970-2005 time series of marine fisheries catches for the entire mainland Tanzania by 35 percent. This is considered conservative (Martin Guard, Eco2 Dive- Centre[2], pers. comm.), but there was no quantitative basis for adjusting the figures upwards.

Small-scale fishing accounts for at least 95 percent of the reported country data. Official reports show that small-scale fisheries produce almost half of shrimp (the primary industrial product) and that, overall, shrimp production is small according to data reported by FAO (1,200 t in the late 1980s to a peak of 2,800 t in 1998), particularly when compared to neighboring country of Mozambique (8,000-15,000 t since the 1980s). Thus, we have no way of gauging the degree to which industrial shrimp catches are underreported.

[2] Eco2, Ltd., PO Box 784, Mtwara, Tanzania, http://www.eco2.com/

But given that industrial catches make up less than 5 percent of reported data, the 35 percent increase in the data overall may account (minimally) for discards by the shrimp industry.

But this time series of fisheries catches for 1950-2005 (which included a 35 percent increase in reported catches for the last 35 years) did not include collector data. The only years for which we had estimates of collectors were 2001 and 2005, which, though they appear to be small (576 and 796 collectors respectively), were the result of recent mainland frame surveys and thus presumed to be reliable. We interpolated the number of collectors between 2001 and 2005. For years 1970-2000, for which we had reliable number of fishers, we took the ratio of collectors to fishers from 2001 (3:100) and applied that to 1970-2000 (Table 2).

We then multiplied the number of collectors by the same catch and effort for collectors from Matemwe, Zanzibar (4.0 kg·collector$^{-1}$ for 240 days·year$^{-1}$) to get a time series of collector catch. Because we had little information on the number of fishers and nothing on the number of collectors from 1950-1969, we took collector catch as a ratio to fishers catch (0.8:100 in 1970) and then used this ratio to determine conservative collecting estimates for 1950-1969 (57-260 t·year$^{-1}$). Then we aggregated collecting and fisher catches for total marine catch estimates for Tanzania mainland.

Finally, we aggregated the total catches (fishers and collectors) for Zanzibar and the Tanzania mainland to obtain an estimate of total catches for the United Republic of Tanzania from 1950-2005 (Table 3).

**Table 2.** Number of fishers and collectors on the Tanzanian mainland, 1970-2005.

| Year | No. of fishers | No. of collectors |
|---|---|---|
| 1970 | 6,719[a] | 202 |
| 1971 | 8,200[b] | 246 |
| 1972 | 8,531[b] | 256 |
| 1973 | 8,188[b] | 246 |
| 1974 | 8,331[c] | 250 |
| 1975 | 8,500[b] | 255 |
| 1976 | 11,157[d] | 335 |
| 1977 | 10,033[d] | 301 |
| 1978 | 9,800[b] | 294 |
| 1979 | 8,100[b] | 243 |
| 1980 | 7,600[b] | 228 |
| 1981 | 13,200[b] | 396 |
| 1982 | 13,500[b] | 405 |
| 1983 | 9,500[b] | 285 |
| 1984 | 13,783[e] | 413 |
| 1985 | 11,392[f] | 342 |
| 1986 | 12,619 | 379 |
| 1987 | 12,739 | 382 |
| 1988 | 13,855 | 416 |
| 1989 | 13,887 | 417 |
| 1990 | 16,178 | 485 |
| 1991 | 16,361 | 491 |
| 1992 | 15,027 | 451 |
| 1993 | 15,027 | 451 |
| 1994 | 15,027 | 451 |
| 1995 | 13,822 | 415 |
| 1996 | 13,822 | 415 |
| 1997 | 13,822 | 415 |
| 1998 | 20,625 | 619 |
| 1999 | 20,625 | 619 |
| 2000 | 20,625 | 619 |
| 2001 | 19,071 | 576[g] |
| 2002 | 19,071 | 631 |
| 2003 | 19,071 | 686 |
| 2004 | 19,071 | 741 |
| 2005 | 29,754 | 796[h] |

[a](Fisheries Division, 1970) [b](Bagachwa *et al.*, 1994) [c] (Fisheries Division, 1975) [d](Mikisi, 1984) [e](Bagachwa et al., 1994) [f]1985-2005 (F. Sobo, Fisheries Division, pers. comm.) [g](Fisheries Division, 2002) [h](Fisheries Division, 2005)

## RESULTS

Time series data is presented for the Tanzanian mainland and Zanzibar (Figure 2). Catch reconstructions for Zanzibar show that total marine catches over the last few decades range between 10-25,000 t. On the mainland, marine catches range from 36-77,000 t over the last 20 years or about three times those of Zanzibar. There is approximately the same number of fishers on the mainland as on Zanzibar (~20,000) and approximately the same number of landing sites (200); however mainland fishers are distributed over a much larger space, and they appear to access healthier resources. Thus, catch per fisher rates are much higher on the mainland, confirming that fishers in Zanzibar are worse off than those on the mainland. This point is further validated by a household survey of fishers, wherein 51 percent of respondents in Pemba, Zanzibar took three meals a day while 90 percent of fishers on Mafia island did (Tobey and Torell, 2006). However, mainland fisheries catches also appear to be declining in recent years. Anecdotes from the mainland also suggest that species composition for certain fisheries (e.g., the purse seine fishery in Tanga) have changed (Nhwani, 1981).

**Table 3.** Time series of marine fisheries catches (t) for Zanzibar fishers and collectors, mainland fishers and collectors, and the United Republic of Tanzania total, 1950-2005.

| Year | Zanzibar catch (t) | | Mainland Tanzania catch (t) | | Total Catch (t) |
|---|---|---|---|---|---|
| | Fishers | Collectors | Fishers | Collectors | |
| 1950 | 6,250 | 2,063 | 7,100 | 57 | 15,469 |
| 1951 | 6,500 | 2,145 | 7,100 | 57 | 15,802 |
| 1952 | 6,750 | 2,228 | 8,100 | 65 | 17,142 |
| 1953 | 7,000 | 2,310 | 13,400 | 107 | 22,817 |
| 1954 | 7,250 | 2,393 | 13,400 | 107 | 23,150 |
| 1955 | 7,500 | 2,475 | 14,100 | 113 | 24,188 |
| 1956 | 7,750 | 2,558 | 14,100 | 113 | 24,520 |
| 1957 | 8,000 | 2,640 | 14,100 | 113 | 24,853 |
| 1958 | 8,250 | 2,723 | 14,100 | 113 | 25,185 |
| 1959 | 8,500 | 2,805 | 14,000 | 112 | 25,417 |
| 1960 | 8,750 | 2,888 | 14,300 | 114 | 26,052 |
| 1961 | 9,000 | 2,970 | 16,600 | 133 | 28,703 |
| 1962 | 9,250 | 3,053 | 17,800 | 142 | 30,245 |
| 1963 | 9,500 | 3,135 | 12,500 | 100 | 25,235 |
| 1964 | 9,750 | 3,218 | 23,400 | 187 | 36,555 |
| 1965 | 10,000 | 3,300 | 22,800 | 182 | 36,282 |
| 1966 | 10,250 | 3,383 | 29,700 | 238 | 43,570 |
| 1967 | 10,500 | 3,465 | 30,000 | 240 | 44,205 |
| 1968 | 10,750 | 3,548 | 32,500 | 260 | 47,058 |
| 1969 | 11,000 | 3,630 | 27,500 | 220 | 42,350 |
| 1970 | 11,250 | 3,713 | 25,110 | 194 | 40,266 |
| 1971 | 11,500 | 3,795 | 29,565 | 236 | 45,096 |
| 1972 | 11,750 | 3,878 | 39,015 | 246 | 54,888 |
| 1973 | 12,000 | 3,960 | 32,400 | 236 | 48,596 |
| 1974 | 12,250 | 4,043 | 35,571 | 240 | 52,104 |
| 1975 | 12,500 | 4,125 | 69,039 | 245 | 85,909 |
| 1976 | 12,619 | 4,164 | 67,458 | 321 | 84,562 |
| 1977 | 12,738 | 4,203 | 63,443 | 289 | 80,673 |
| 1978 | 12,856 | 4,243 | 63,886 | 282 | 81,267 |
| 1979 | 12,975 | 4,282 | 45,692 | 233 | 63,182 |
| 1980 | 13,094 | 4,373 | 51,292 | 219 | 68,978 |
| 1981 | 16,466 | 3,779 | 52,533 | 380 | 73,158 |
| 1982 | 21,464 | 3,186 | 36,501 | 389 | 61,540 |
| 1983 | 17,902 | 2,592 | 45,195 | 274 | 65,963 |
| 1984 | 21,632 | 1,999 | 55,202 | 397 | 79,229 |
| 1985 | 15,205 | 1,405 | 57,843 | 328 | 74,782 |
| 1986 | 10,094 | 1,612 | 63,430 | 363 | 75,499 |
| 1987 | 16,648 | 1,818 | 52,778 | 367 | 71,611 |
| 1988 | 10,402 | 2,024 | 66,667 | 399 | 79,492 |
| 1989 | 9,627 | 2,230 | 67,827 | 400 | 80,083 |
| 1990 | 8,887 | 2,044 | 76,652 | 466 | 88,049 |
| 1991 | 7,999 | 1,840 | 73,363 | 471 | 83,673 |
| 1992 | 11,781 | 2,710 | 59,246 | 433 | 74,170 |
| 1993 | 9,409 | 2,164 | 49,525 | 433 | 61,531 |
| 1994 | 11,101 | 2,553 | 55,060 | 433 | 69,147 |
| 1995 | 9,789 | 2,251 | 68,949 | 398 | 81,387 |
| 1996 | 11,034 | 2,538 | 72,252 | 398 | 86,222 |
| 1997 | 9,966 | 2,292 | 72,284 | 398 | 84,941 |
| 1998 | 13,638 | 3,137 | 70,516 | 594 | 87,885 |
| 1999 | 14,444 | 3,322 | 67,500 | 594 | 85,860 |
| 2000 | 17,922 | 4,122 | 67,365 | 594 | 90,003 |
| 2001 | 20,542 | 4,725 | 71,462 | 553 | 97,281 |
| 2002 | 20,343 | 4,679 | 67,061 | 606 | 92,688 |
| 2003 | 20,861 | 4,798 | 66,515 | 659 | 92,832 |
| 2004 | 21,867 | 5,029 | 68,135 | 711 | 95,742 |
| 2005 | 23,185 | 5,333 | 67,500 | 764 | 96,782 |

The total reconstructed catch for the United Republic of Tanzania is presented for 1950-2005 along with the FAO data, which represent reported landings (Figure 3). Since 2000, the FAO has reported catches between 49,500 and 53,000 t, while the present study suggests catches between 90,000 and 97,500 t for the same time period. Overall, for the 1950-2005 period, the reconstructed catch is 1.7 times larger than that reported by FAO.

## DISCUSSION

As the seafood market globalizes and the coastal population of Tanzania continues to grow at high rates (as does the country's population as a whole), coastal fisheries resources have come under increasing pressure. But this is not always reflected in the official statistics.

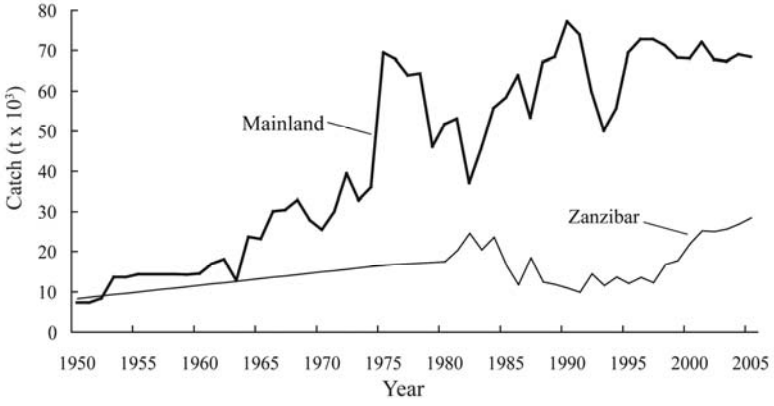


**Figure 2.** Marine fisheries catch reconstructions for the Tanzanian mainland and Zanzibar, 1950-2005.

Though there is a large degree of uncertainty with the present catch reconstructions, the assumptions made for this study are better than the alternative, i.e., the omission of Zanzibar from official reports and the chronic underreporting of mainland Tanzania catches. The result is that the reconstructed catches now incorporate Zanzibar into the overall marine fish catches statistics, they estimate catches by collectors on both the mainland and Zanzibar, and that they compensate for general underreporting on the Tanzania mainland. The finding that the reconstructed Tanzanian catches are 1.7 times larger than the catches presented by FAO over the 1950-2005 period supports the findings of van der Elst *et al.* (2005), which, based on calculations made for Africa's seven Western Indian Ocean countries, estimated that the FAO statistics reflect only half of the total real catch.

The present catch reconstruction also confirms reports of declining catch rates on the mainland (Silva, 2006). Historically, fishers in Tanzania were considered better off than farmers (Wenban-Smith, 1965), but this changed as catches became divided among more and more fishers (Shao *et al.*, 2003). Anecdotes and available fisheries data suggest that fishing grounds within range of the vessels were maximally exploited in the early 1980s (Ngoile, 1982). Catch per fisher also peaked in the early 1980s, though it could be that the high catches reported in the early 1980s were a result of improved statistics, such as those introduced in 1981 (Jiddawi and Muhando, 1990), and catch per fisher actually peaked earlier. On the mainland, catch per fisher in the mid-1990s was roughly 5 $t \cdot fisher^{-1} \cdot year^{-1}$, while in recent years, it has been around 3.5 $t \cdot fisher^{-1} \cdot year^{-1}$. Today, many mainland fishers are also farmers and own one to two hectares of land for farming when fishing is difficult (Shao *et al.*, 2003).

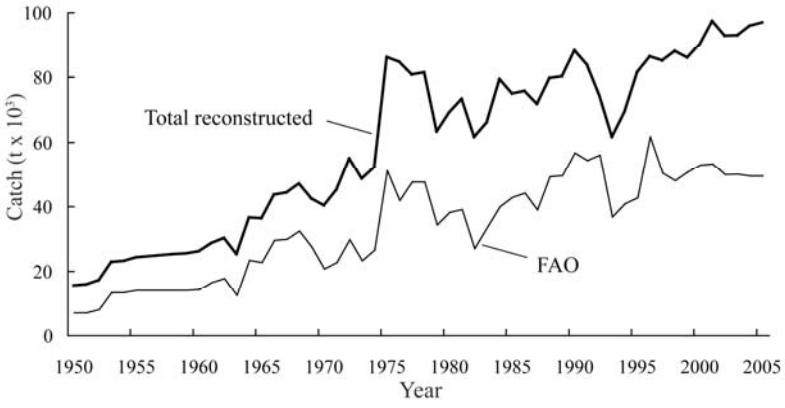


**Figure 3.** Total reconstructed marine fisheries catches for the United Republic of Tanzania compared to FAO reported catch, 1950-2005.

On Zanzibar, the population growth rate (~3.0 percent) is even higher than that of the mainland (~2.8 percent). Furthermore, there is almost an equal number of fishers on Zanzibar as the mainland (20,000) and they compete for resources in a much smaller coastal area. Though fisheries catches in Zanzibar in recent years are similar to those from the early 1980s, this catch is divided among almost double the number of fishers. Thus high catches in recent years are not a result of improved ecosystem health but rather due to much greater fishing pressure due to high population growth, lack of arable land, and the growth in tourism. In 1969, Zanzibar had a total of 80 landing sites. By 1990, there were nearly 200

(Jiddawi and Muhando, 1990). Today, catch rates per fisher are much lower in Zanzibar than on the mainland and range between 0.5 and 1 5 $t \cdot fisher^{-1} \cdot year^{-1}$, confirming that fishers in Zanzibar are among the poorest and most disadvantaged in Tanzanian society (Suleiman, 1999). Fishers in Zanzibar are also more heavily reliant on fish for protein than mainland fisheries, due to the shortage of arable land on the islands.

It is difficult to know how much fishing has deteriorated, though, due to the lack of emphasis on marine fisheries research. Jiddawi and Stanley (1999) provided the first "baseline observations, which can be followed over time." A late 1990s baseline will have obvious implications for marine management and/or ecosystem restoration. But poor data is no longer a good excuse for poor management, especially for nearshore finfisheries (Johannes, 1998).

Tanzania has enacted good fisheries legislation with calls for better data collection, though these efforts have been stymied due to lack of resources and likely the remoteness of fishing communities. The National Fisheries Sector Policy was adopted by the government in 1997 and stressed the need to understand the fisheries resource base and banned some destructive fishing practices, such as beach seining. However, they are still practiced (Othman, 1999; Verheij *et al.*, 2004; Mngulwi, 2006). Beach seining catches juveniles of many valuable species, such as snappers, scavengers and emperors (Nhwani, 1981).

Until just recently, fisheries management in Tanzania has almost entirely focused on the great lakes (Mngulwi, 2006). Assuming catches for freshwater systems do not suffer the same level of underreporting as marine fisheries, the present results show that marine catches account for 25-30 percent of total fisheries catches in Tanzania, rather than 10-15 percent as suggested by previous reports (Mgawe, 2005). This has obvious implications for the future of marine fisheries management, including national management efforts and foreign aid. Furthermore, this area of the Western Indian Ocean is more important than has otherwise been noted.

According to FAO statistics, the Western Indian Ocean represents 8 percent of the world's oceans but generates only 4 percent of reported landings (van der Elst *et al.*, 2005). As evidenced by this work and a similar study of Mozambique (Jacquet and Zeller, this volume), this discrepancy is a better indicator of underreporting of the small-scale sectors than of productivity. The marine fishing sector is a more important asset to food security and the magnitude of resource extraction much greater than was previously recognized. It may be true that collector catch estimates should be even larger than the ones generated here and that marine fish provides an even greater part of the coastal Tanzanians' diet.

On Zanzibar, collectors account for about 20 percent of the total catch while on the mainland the collector catch is less than one percent of total catch. Perhaps farming is much more productive on the mainland due to greater areas of arable land but perhaps the number of collectors is greatly underestimated. The number of reported collectors in the whole of Tanzania seems low in comparison with those reported for Mozambique (nearly 50,000) and further research should explore the extent and effort of collectors on the Tanzanian shore.

Though Malthusian overfishing - a combination of population growth and destructive fishing gear (Pauly, 2006) - is likely at work in Tanzania, increasingly global markets for seafood are also to blame. In 2002, there were 12 licensed industrial fishing vessels fishing in Tanzania's EEZ (Jiddawi and Öhman, 2002). By 2004, this number had grown to 24 (Mngulwi, 2006). Now, there is a recent government provision to lift the export ban on marine finfish and allow ten different groups of fish to be exported: tunas and kingfishes, carangids (jacks), parrotfish, and bluefish, red snapper, groupers, rock cod, rays and skates, soles, marlines, and catfishes (Mgawe, 2005).

The Fisheries Division believes that an export fishery would reduce local poverty (Anderson and Ngatunga, 2005). However, finfish provide an important protein source to coastal communities and account for about 60 percent of animal protein consumed (Shao *et al.*, 2003; Mngulwi, 2006). Furthermore, Anderson and Ngatunga (2005) point out that an export fishery would raise prices and reduce the supply to domestic markets and exacerbate hunger (Mgawe, 2000).

Furthermore, lessons from Lake Victoria's export fishery should be considered. At Lake Victoria, the export trade is dominated by a select few companies and fishers are price-takers (i.e., controlled by their credit relationship with large buyers) (Anderson and Ngatunga, 2005). Returns rarely go to fishers.

The impact of the global seafood market on fisheries, particularly those with weak management, is predictable. Foreign demand for crustaceans has caused the overfishing of lobsters and shrimp. The lobster catch peaked in the late 1980s and, since then, the average size of lobster has decreased (Bakari

and Andersson, 1999; Jiddawi and Öhman, 2002). In just one decade, the CPUE for prawns declined from 610 kg·day$^{-1}$ in 1990 to 307 kg·day$^{-1}$ in 2001 (Mngulwi, 2006). The Asian market offers high prices for shark fins ($50·kg$^{-1}$) and, consequently, sharks are now heavily targeted (Jiddawi and Shehe, 1999) and overfished in many areas off Tanzania (Guard *et al.*, 2000).

This study indicates that the coastal population of Tanzania is exploiting fisheries resources to a degree that may be threatening their food security. Unless there is a way to ensure local fishers receive the benefits of an export fishery, there is no immediate reason to allow international markets to stimulate additional fishing effort, too.

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